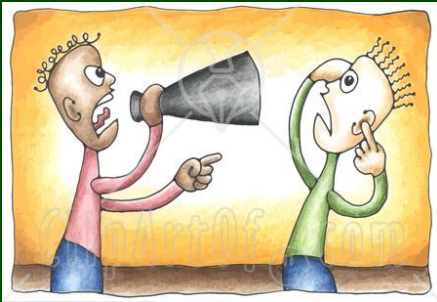


Nuclear Data in Nucleonica

Zsolt Sóti



Not Accurate
Deformation of the content



More accurate
Very time consuming

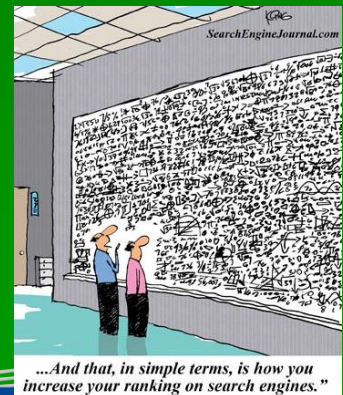


Problematical distribution

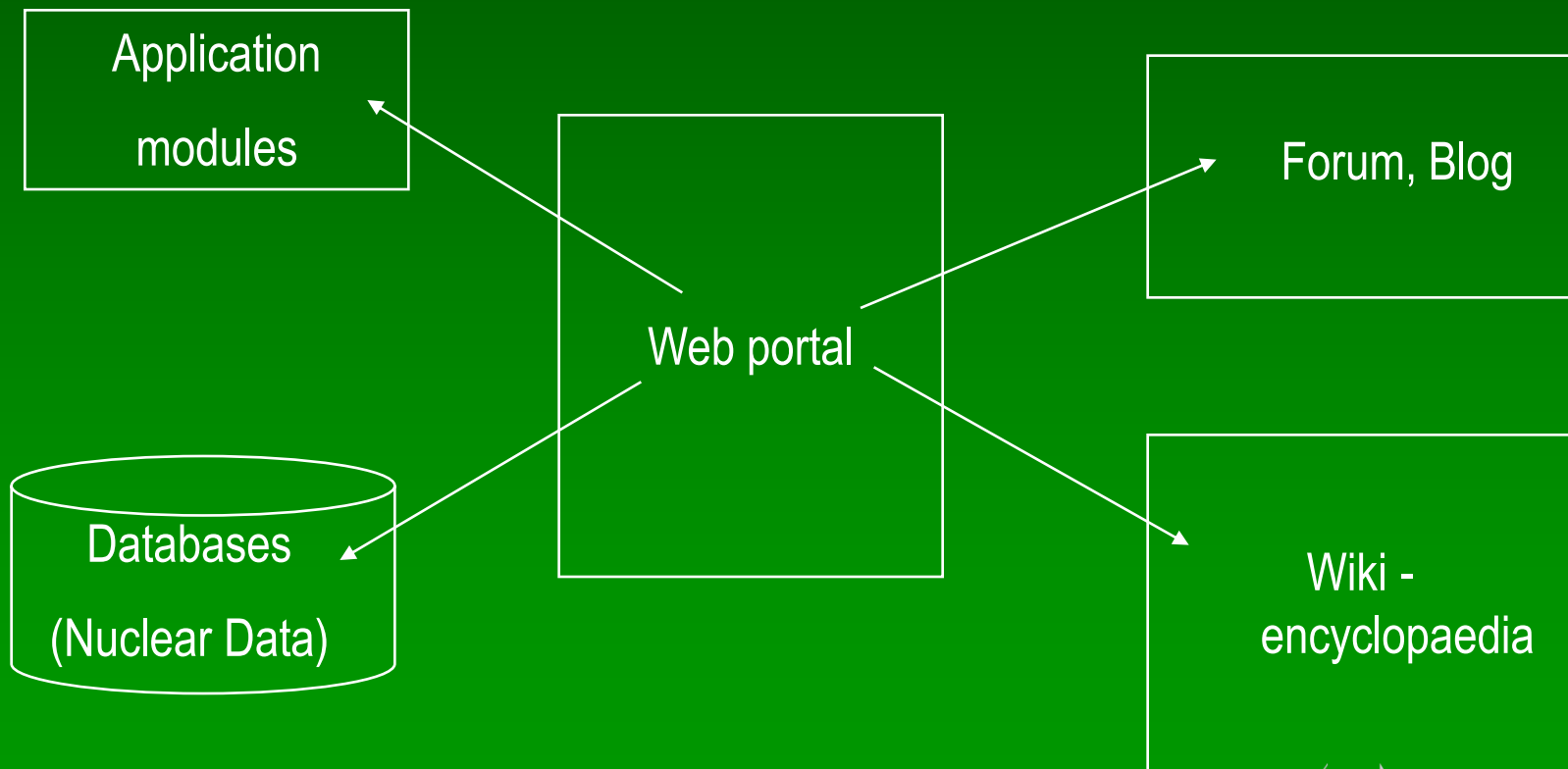
How to distribute tacit
knowledge of different
computer programs?



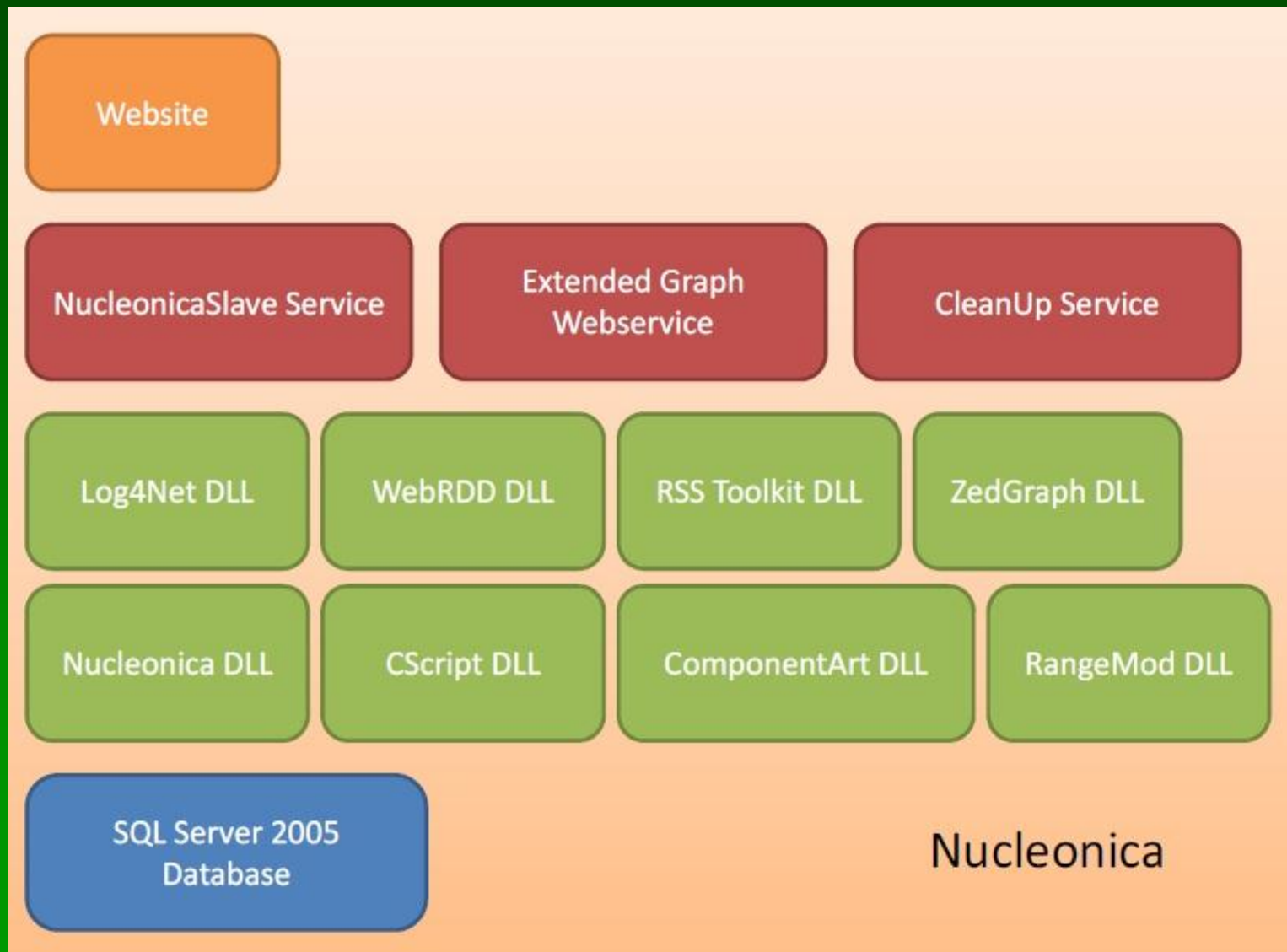
Easy distribution



Nucleonica's Electronic Knowledge Objects (EKO's)

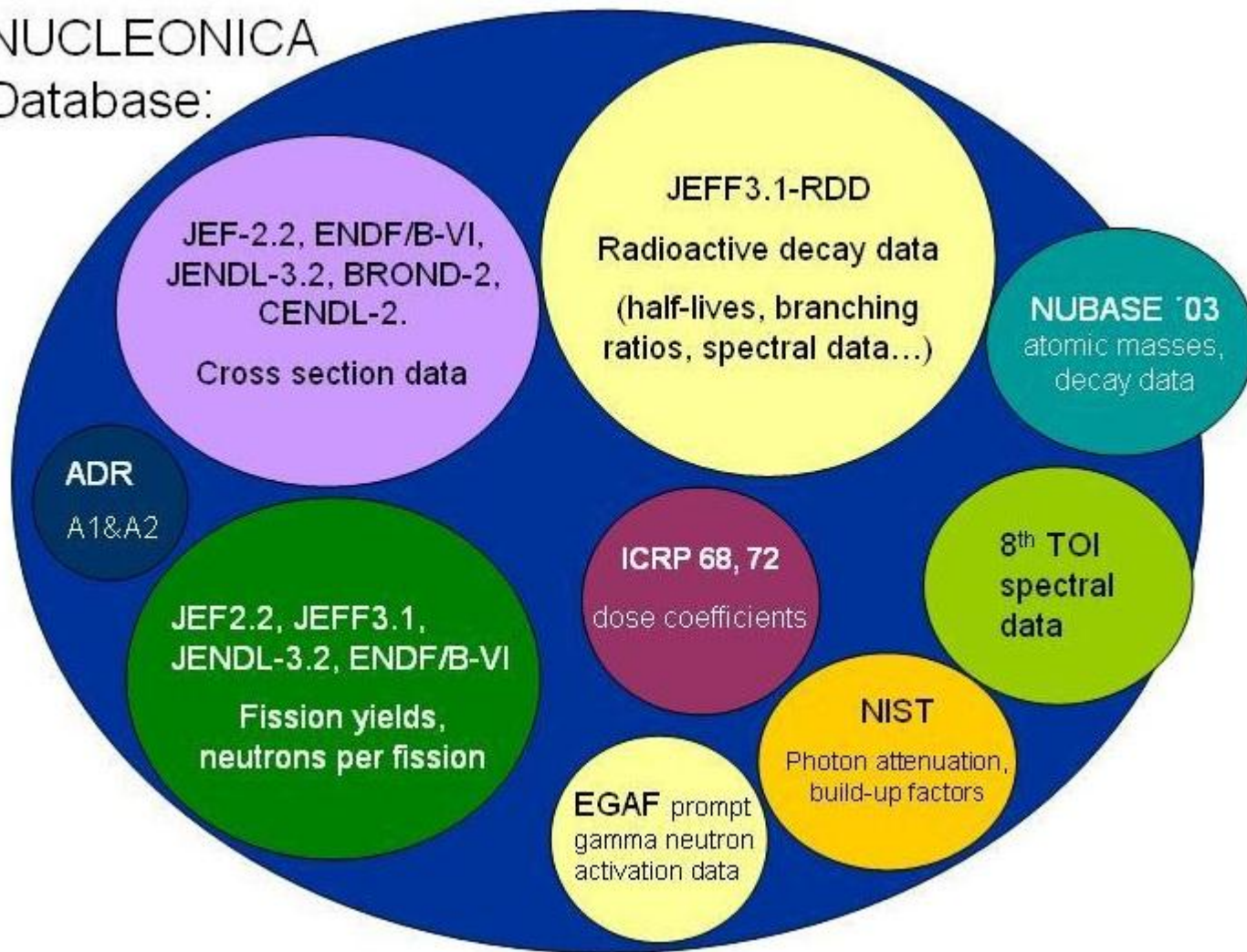


IT objects



Database

NUCLEONICA
Database:



Nuclear Data Applications

- Universal Nuclide Chart
- Nuclide Data Sheets
 - Reference Data
 - Derived Data
 - Radiations
- Nuclide Explorer
- Nuclear Data Retrieval
 - Nuclide Search
 - Radiation Search
 - Dose Coefficients Search
- Karlsruhe Chart of Nuclides

http://www.nucleonica.com/Administration/Administration.as

File Edit View Favorites Tools Help

★ Favorites Nucleonica ...web driven nuclear science

Periodic Table	414	0.10	
Dosimetry & Shielding	54690	13.32	
Universal Nuclide Chart	24474	5.96	
Range & Stopping Power	13390	3.26	
Decay Engine for Large Nuclide Sets	1659	0.40	
Mass Activity Calculator	30095	7.33	
Gamma Spectrum Generator	29050	7.08	
Karlsruhe Nuclide Chart	10755	2.62	
Nuclear Constants	4210	1.03	
Decay Engine	38993	9.50	
KORIGEN	7596	1.85	
Datasheet	102383	24.94	
Energy Level Diagram	635	0.15	
webGraph	3239	0.79	
Geant4 Dosimetry	54	0.01	
Fission Yields	10050	2.45	
In Silico	607	0.15	
Nucleonica Scripting	2298	0.56	
Nuclide Explorer	40299	9.82	
Nuclide Mixtures	8187	1.99	
Gamma Library	5019	1.22	
Gamma Spectrum Generator Pro	4815	1.17	
Total (29 applications)	410499	99.98	

Where to find nuclear data in Nucleonica?

Windows Internet Explorer

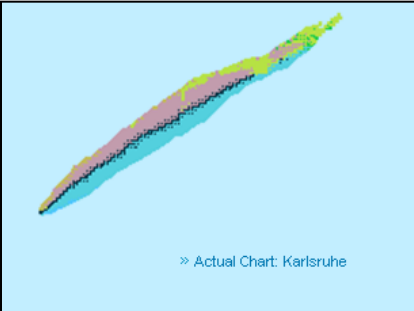
http://www.nucleonica.com/Application/portal.aspx

File Edit View Favorites Tools Help

★ Favorites Nucleonica - Portal

Applications Data Knowledge My Preferences Networking Nuclear Science Help New Browser New Alerts

► Nuclide Explorer



» Actual Chart: Karlsruhe

► Search Nucleonica Documentation

Nuclear Data Retrieval

nucleonica
[wiki]

► Application Centre

- » Mass Activity Calculator, Converter **New:** Mass Activity Converter
- » Decay Engine
- » Dosimetry & Shielding
- » Range & Stopping Power
- » In Silico Dosimetry
- » webKORIGEN
- » Decay Engine for Large Nuclide Sets
- » Universal Nuclide Chart
- » Transport & Packaging
- » Nuclide mixtures
- » Nucleonica Scripting
- » Gamma Spectrum Generator
- » Gamma Spectrum Generator Pro
- » Virtual Cloud Chamber
- » Cambio file Converter
- » WESPA
- » Gamma Library
- » webGraph

► Data Centre

- » Physical Constants
- » Nuclide Explorer
- » Nuclide Datasheets (Reference Data, Derived Data, Cross Sections, Radiations)
- » Nuclear Data Retrieval (Nuclide Search, Radiation Search, Dose Coefficients)
- » Fission Yields
- » Universal Nuclide Chart

► Knowledge Centre

Welcome, gergely

[My Settings](#)
[Networking](#)

► My Last Nuclides

- 27 Co60
- 55 Cs137
- 6 C14
- 9 F18
- 39 Y88

► My Nuclide Mixtures

- Natural Uranium
- Natural Thorium
- Supernova Uranium
- U232+Co60
- Transuranics in 1 ton Spent Fuel

► My Sources

No sources selected yet

► My Messages

No messages at the moment

► User Alerts

- 24/03/2011 14:04:15 Task completed (In Silico)
- 24/03/2011 14:04:15 Task completed (In Silico)
- 24/03/2011 14:04:15 Task completed (In Silico)
- 24/03/2011 14:04:15 Task completed (In Silico)
- 24/03/2011 14:04:15 Task completed (In Silico)
- 24/03/2011 14:04:15 Task completed (In Silico)

» View all

Universal Nuclide Chart

File Options Help

Element name Select Nuclide **Chart Size**

Uranium ▼ U ▼ 238 ▼ **Start** **Decay Chain** **Reaction Path** **Colour** 15 x 15 ▼

Bk 239 (Z=97, N=142):
half-life: 3.0 min
burnout time: No data!

CrossSections (barns): No data!

Daughters:
Alpha (?%, Am 235)
Beta+ (?%, Cm 239)

Legend:

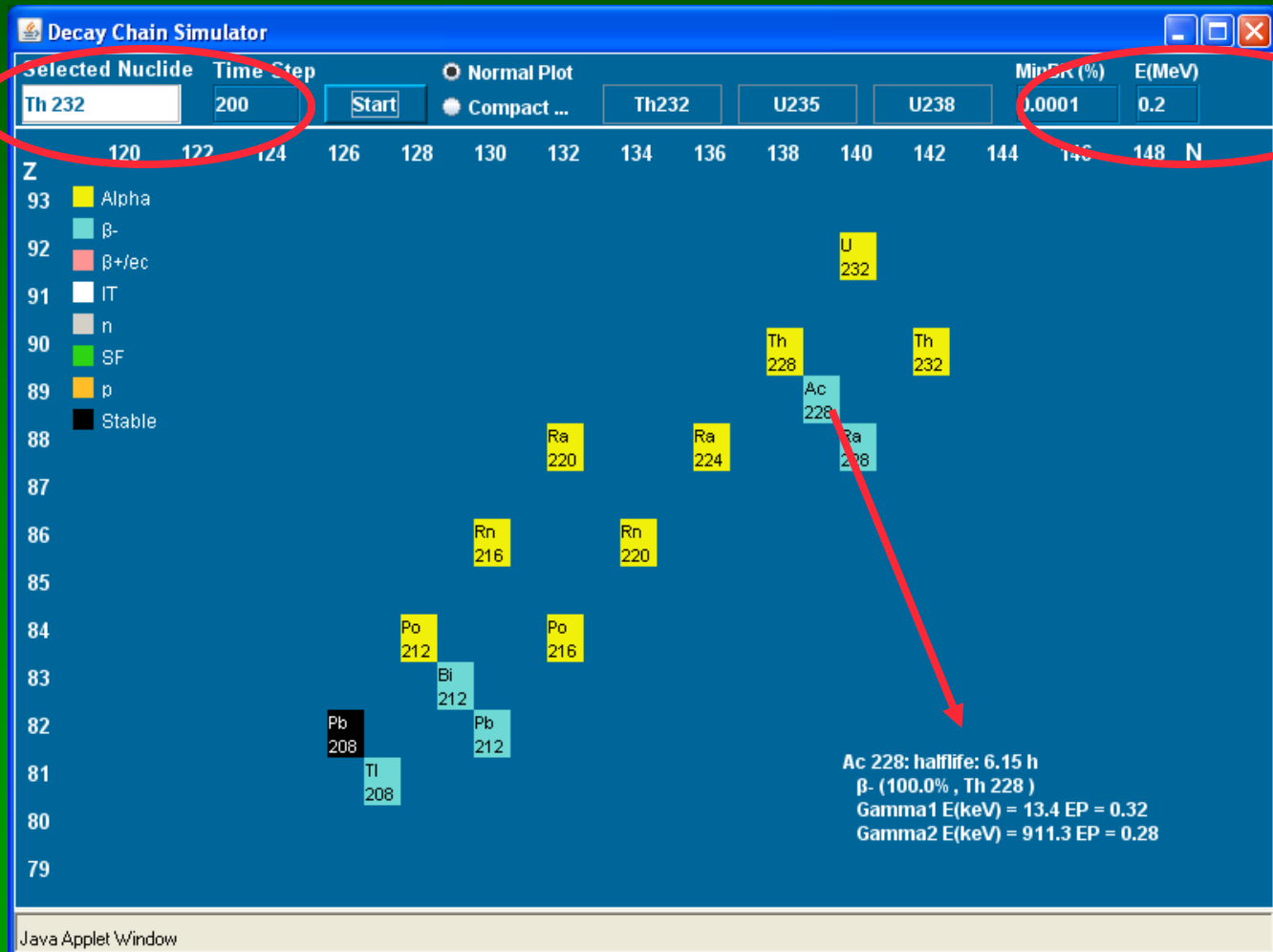
- Alpha
- Beta-
- Beta+/ec
- IT
- n
- SF
- p
- Stable



Universal Nuclide Chart – Exercise 1

The decay chain of Th-232

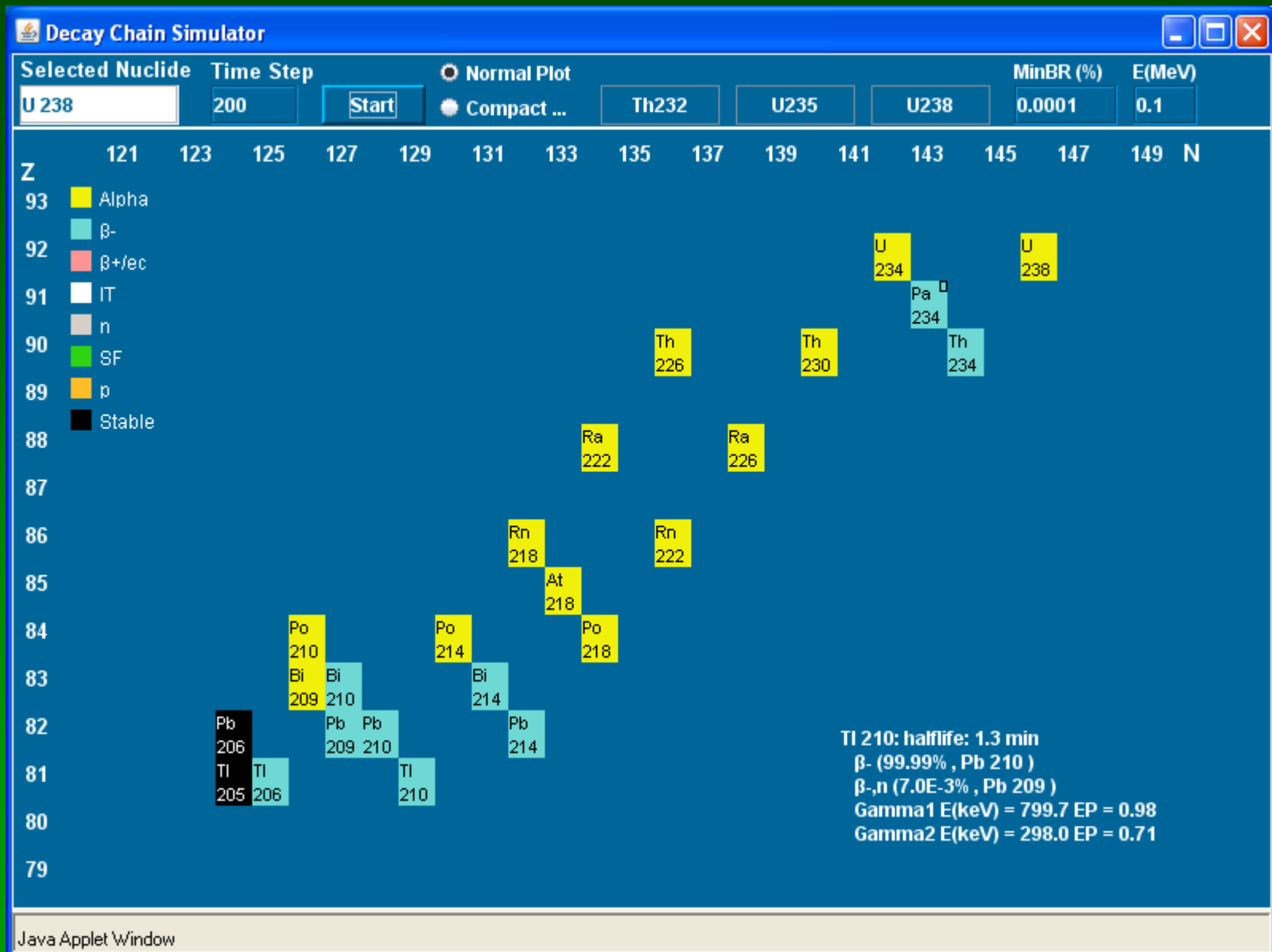
Gamma lines over 200 keV - blinking



Universal Nuclide Chart – Exercise 2

Display the decay chain of U-238 and sign the gamma lines over 100 keV.

Solution – Exercise 2



Nuclide Datasheets

Windows Internet Explorer

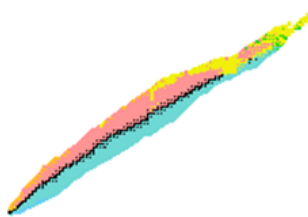
http://www.nucleonica.com/Application/portal.aspx

File Edit View Favorites Tools Help

★ Favorites Nucleonica - Portal

Applications Data Knowledge My Preferences Networking Nuclear Science Help

Nuclide Explorer



» Actual Chart: Karlsruhe

Search Nucleonica Documentation

Nuclear Data Retrieval

nucleonica [wiki]

Application Centre

- » Mass Activity Calculator, Converter **New: Mass A**
- » Decay Engine
- » Dosimetry & Shielding
- » Range & Stopping Power
- » In Silico Dosimetry
- » webKORIGEN
- » Decay Engine for Large Nuclide Sets
- » Universal Nuclide Chart
- » Transport & Packaging
- » Nuclide mixtures
- » Nucleonica Scripting
- » Gamma Spectrum Generator
- » Gamma Spectrum Generator Pro
- » Virtual Cloud Chamber
- » Cambio file Converter
- » WESPA
- » Gamma Library
- » webGraph

Data Centre

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- » Nuclide Explorer
- » Nuclide Datasheets (Reference Data, Derived Data, Cross Sections, Radiations)
- » Nuclear Data Retrieval (Nuclide Search, Radiation Search, Dose Coefficients)
- » Fission Yields
- » Universal Nuclide Chart

Knowledge Centre

Nuclide Datasheets

27 Cobalt

Current Chart: Karlsruhe

Element: Mass: Co 60

Reference Data Description Derived Data Cross Sections **Radiations** Prompt Gammas Select Print Outputs

» Reference Data Notes

Density	8.86 g/cm ³
Mass Excess	-61649.012 (± 628) keV
Atomic Mass	59.933817059 (± 674) u
Half-life	5.271 (± 1) y
Spin	5 h
Parity	+
Binding Energy	
Abundance	
Effective Dose Coefficient Inhalation	
Effective Dose Coefficient Ingestion	
Mean Decay Energies	
Alpha	
Electron	
Photon	
Type of decay	β-
Type of parent decay	
IT	

Download Excel CSV

Nuclide Datasheets

27 Cobalt

Current Chart: Karlsruhe

Element: Mass: Co 60

Reference Data Description Derived Data Cross Sections **Radiations** Prompt Gammas

Nucleonica

☐ Gamma Rays ☐ Beta Rays ☐ Discrete Electrons ☐ X-rays and Annihilation Radiation

Update

24/03/2011 14:04:15 Task completed (In Silico)

24/03/2011 14:04:15 Task completed (In Silico)

» View all

Europäische Kommission

Nuclide Data Sheets – Exercise 3

- Pa-234m is a daughter nuclide of Th-234 which is daughter product of U-238. Using the Nuclide Datasheet find the half-life of Pa-234m and Th-234.
- Find the most important gamma line of Pa-234m

Solution – Exercise 3

http://www.nucleonica.com/Application/Datasheet.aspx?TI=0&MI=912341

Nuclide Datasheets
91 Protactinium

Current Chart: Karlsruhe

Element: Pa Mass: 234 m

Reference Data Description Derived Data Cross Sections Radiations Prompt Gammas Select Print Outputs

Reference Data Notes

Nuclide	^{234m} 91 Pa 143
Density	15.4 g/cm ³
Atomic Mass	234.0433929 (± 83)
Half-life	1.17 (± 3) m
Spin	0 h
Parity	-
Binding Energy	7.59434 MeV/nucleon
Abundance	-
Mean Decay Energies	
Alpha	0 (MeV)
Electron	816.5 (keV)
Photon	19.7392 (keV)
Type of decay	Branching Ratio
β-	0.9985
IT	0.0015
SF	1E-12
Type of parent decay	Branching Ratio
β-	1

Decay Energy, Q	Daughters
2.278 (MeV)	92 U 234
0.079 (MeV)	91 Pa 234
(MeV)	
Decay Energy, Q	Parents
0.192 (MeV)	90 Th 234

http://www.nucleonica.com/Application/Datasheet.aspx?TI=0&MI=912341

Nuclide Datasheets
91 Protactinium

Current Chart: Karlsruhe

Element: Pa Mass: 234 m

Reference Data Description Derived Data Cross Sections Radiations Prompt Gammas Select Print Outputs

Nucleonica

☒ Gamma Rays ☒ Beta Rays ☐ Discrete Electron ☒ X-rays and Annihilation Radiation

Update Show data

Gamma Rays

Number of lines: 126
Sum E.P (eV per disintegration): 1.81E+04

Energy, E(keV)	Emission Probability, E.P.	a _{total}	a _K	a _L
1001.02	0.00835	0.01086	0.0084	0.0021
766.358	0.0031897	0.01864	0.0135	0.0043
742.814	0.0009352	0.00641	0.0053	0.0009
258.2	0.0007348	0.0547	0.044	0.0086
786.272	0.0004843	0.00578	0.0048	0.0008
1737.8	0.00021209	0.003925	0.0033	0.0006
1831.7	0.000172845	0	0	0
1193.77	0.000131095	0.002736	0.00225	0.0004
1510.1	0.00013026	0	0	0
73.92	0.00012525	11.2	0	9
922	0.00012358	0.0515	0.042	0.008
883.237	0.00010855	0.01379	0.0105	0.0028

Solution – Exercise 3

Th234
24.09 d

Nuclide Datasheets

90 Thorium

Current Chart: Karlsruhe

Element: Th Mass: 234

Reference Data | Description | Derived Data | Cross Sections | Radiations | Prompt Gammas | Select Print Outputs

» Reference Data Notes

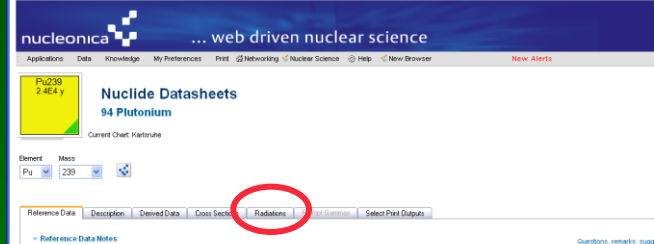
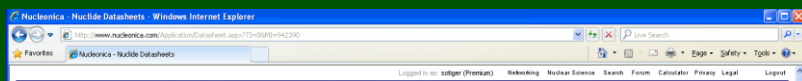
Questions, remarks, suggestions can be posted in the [forum](#)

Nuclide	$^{234}_{90}\text{Th}_{144}$		
Density	11.7 g/cm ³		
Mass Excess	40614.285 (± 3500) keV		
Atomic Mass	234.043601200 (± 3756) u		
Half-life	24.09 (± 3) d		
Spin	0 ⁺		
Parity	+		
Binding Energy	7.59685 MeV/nucleon		
Abundance	-		
Effective Dose Coefficient Inhalation	7.7E-09 (Sv/Bq)		
Effective Dose Coefficient Ingestion	3.4E-09 (Sv/Bq)		
Mean Decay Energies			

Nuclide Data Sheets – Exercise 4

- For the decay of Pu-239, what is the maximum alpha particle energy?

Solution – Exercise 4



Alpha Particles

Number of lines: 59
Sum E.P. (eV per disintegration): 5.15E+06

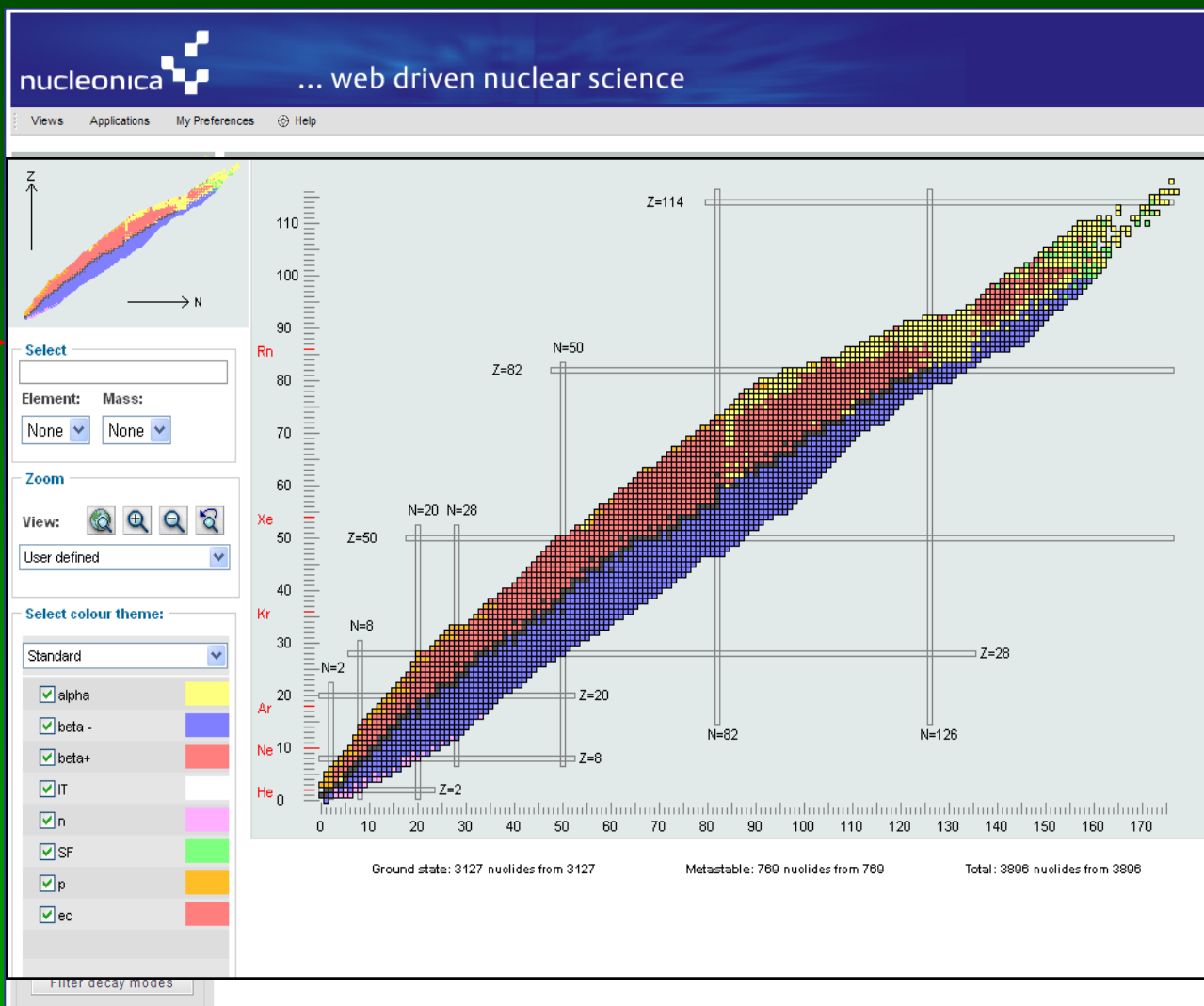
Energy, E(MeV)	Emission Probability, E.P.
5.15665	0.7076
5.1439	0.1716
5.10589	0.1192
5.0764	0.00078
5.0554	0.000468
5.0088	0.00017
4.9882	0.00012
5.0296	9.4E-05
4.9629	7E-05
4.7371	5.8E-05
4.9351	5.5E-05
4.8295	3.8E-05
4.9118	3.1E-05
4.867	1.76E-05
4.7701	1.17E-05

Alpha Particles

Number of lines: 59
Sum E.P. (eV per disintegration): 5.15E+06

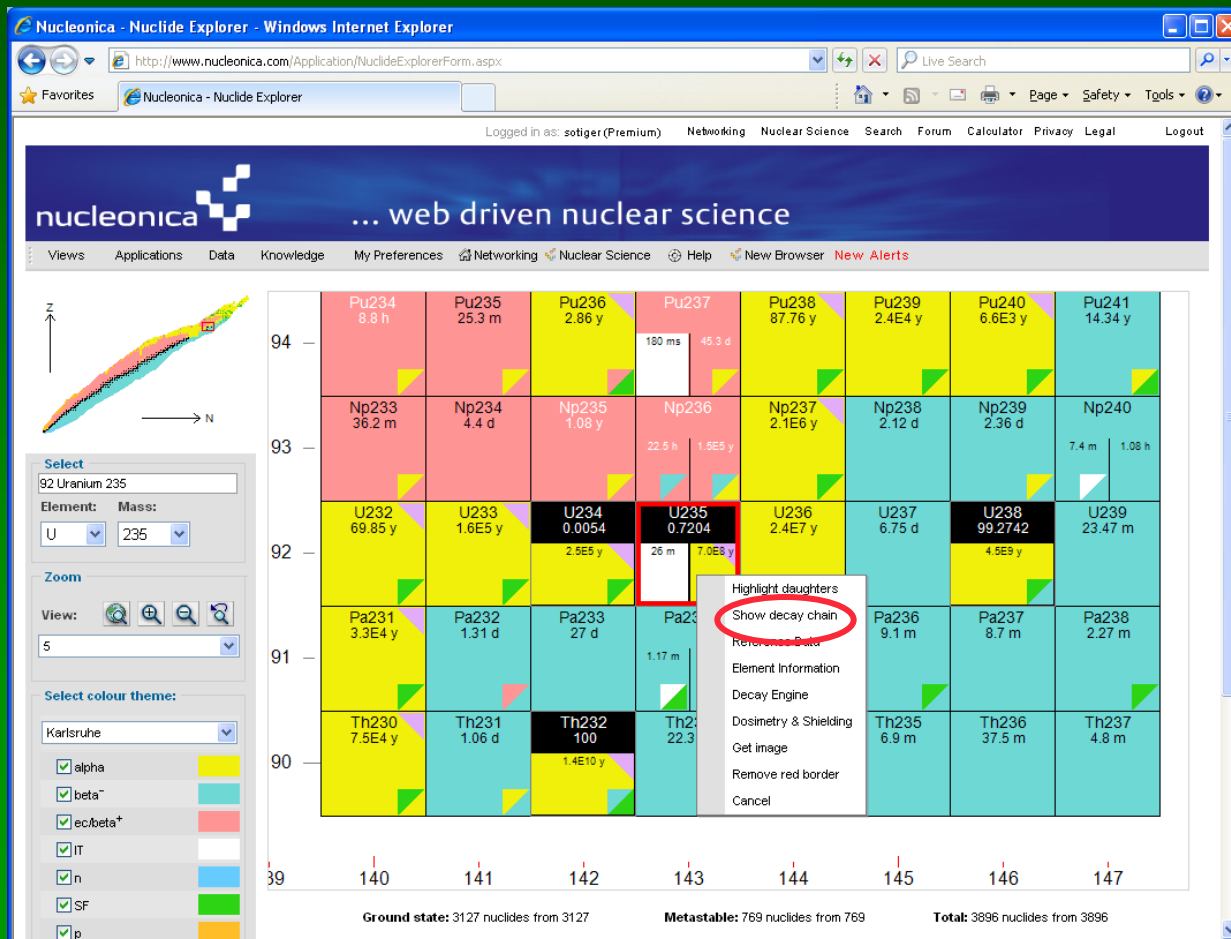
Energy, E(MeV)	Emission Probability, E.P.
5.16E+00	7.08E-01
5.14E+00	1.72E-01
5.11E+00	1.19E-01
5.08E+00	7.80E-04
5.06E+00	4.68E-04
5.03E+00	9.40E-05
5.01E+00	1.70E-04
4.99E+00	8.00E-06
4.99E+00	1.20E-04
4.96E+00	7.00E-05
4.94E+00	5.50E-05
4.91E+00	3.10E-05
4.87E+00	8.10E-06
4.87E+00	1.76E-05
4.83E+00	3.80E-05

Nuclide Explorer

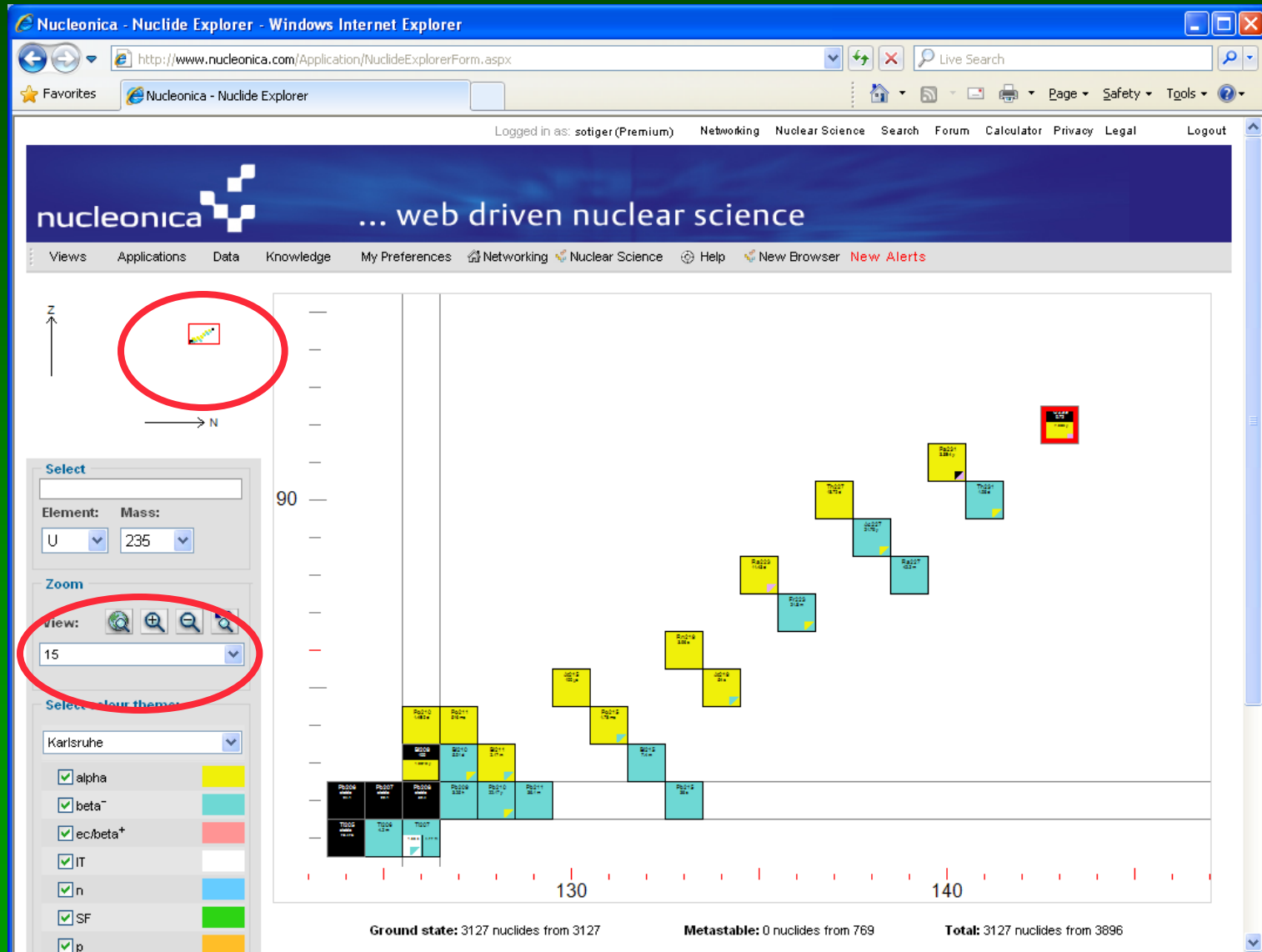


Nuclide Explorer – Exercise 5

- Display the decay chain of U-235.

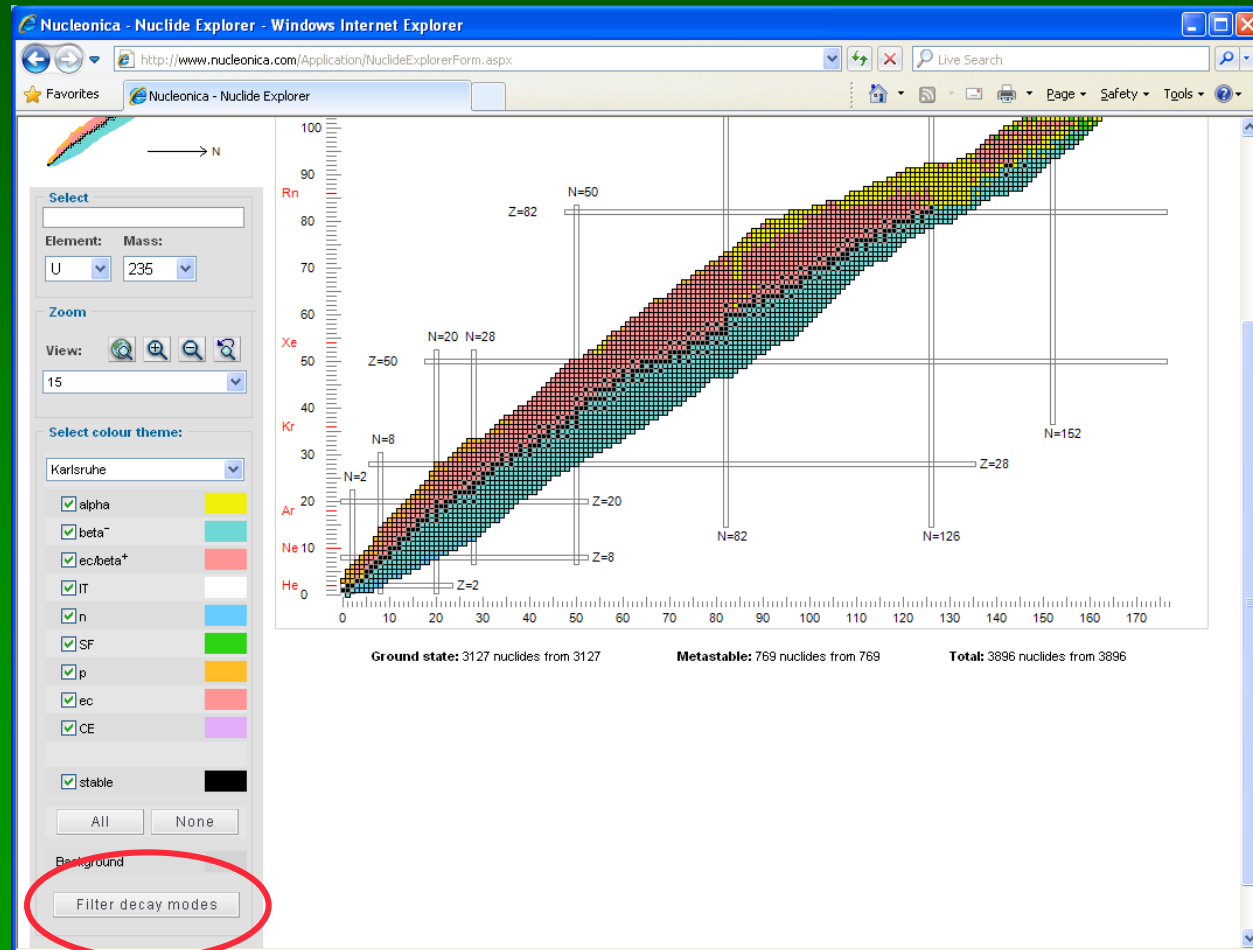


Solution – Exercise 5

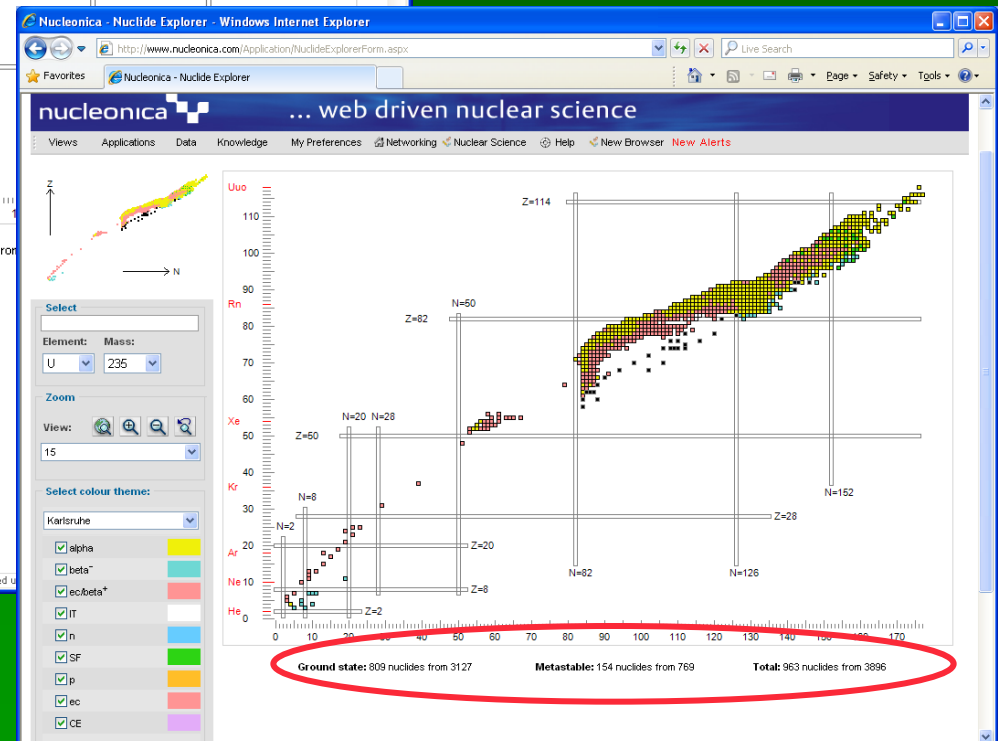
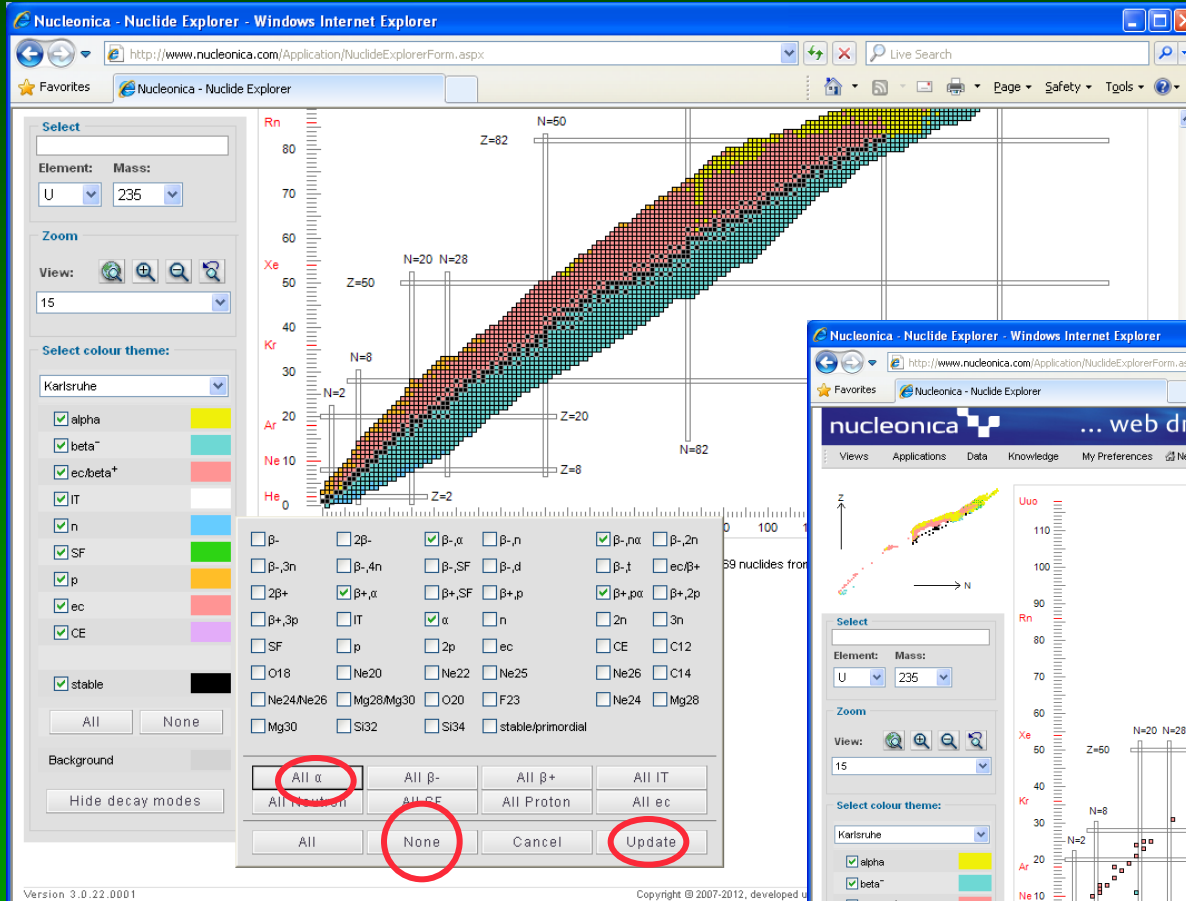


Nuclide Explorer – Exercise 6

- How many nuclides are alpha emitters?

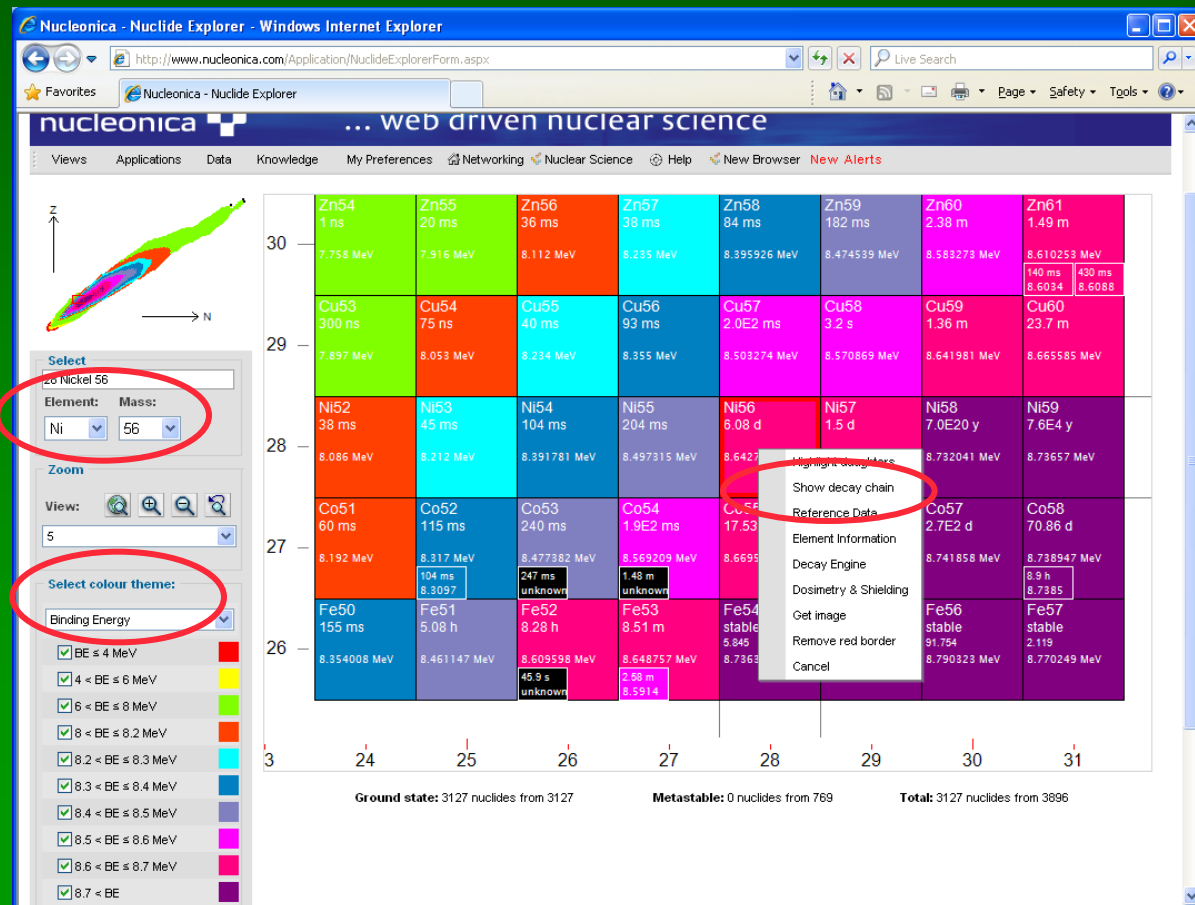


Solution – Exercise 6

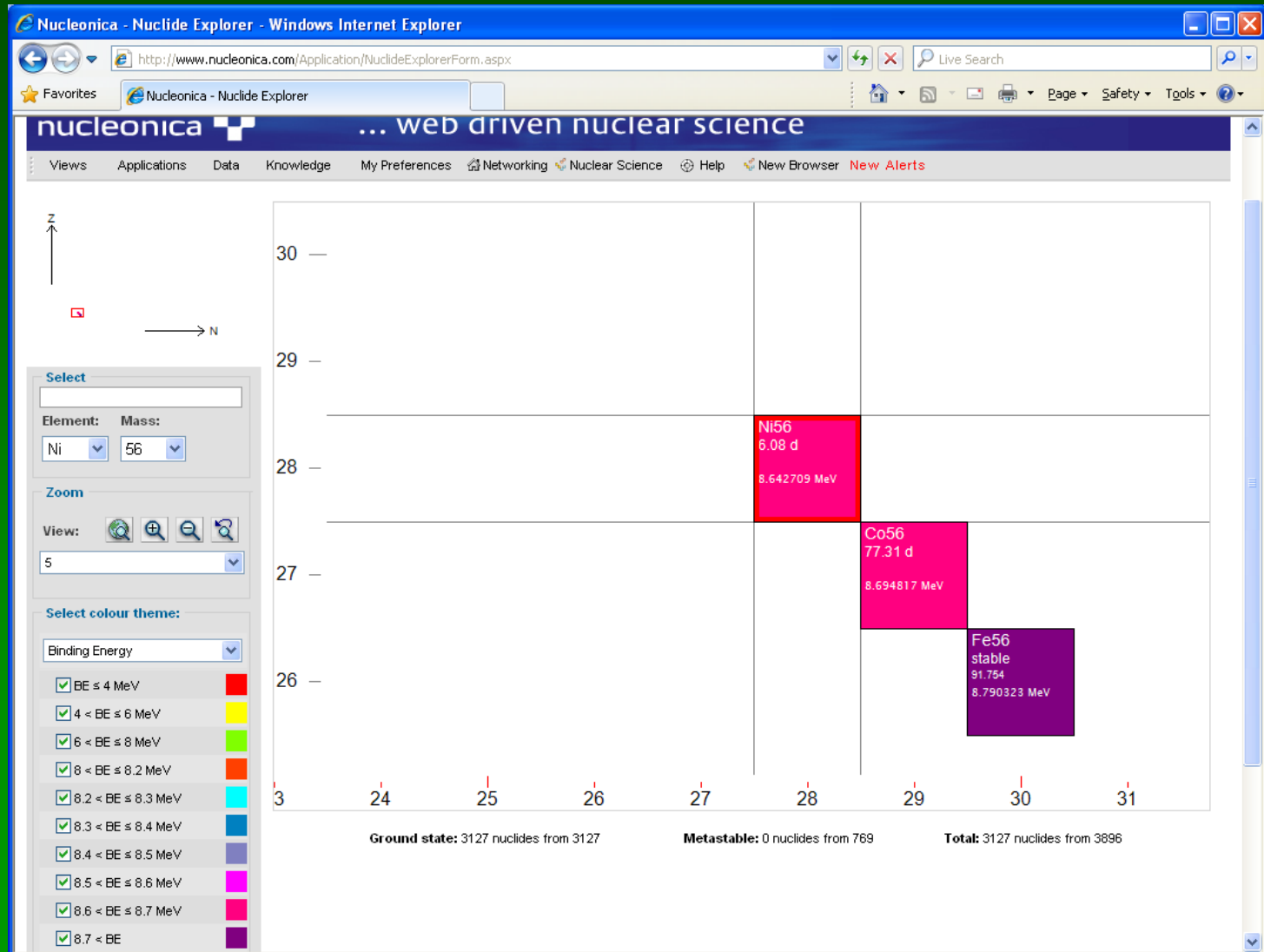


Nuclide Explorer - Exercise 7

- Show how the binding energy is growing. Take Ni-56.

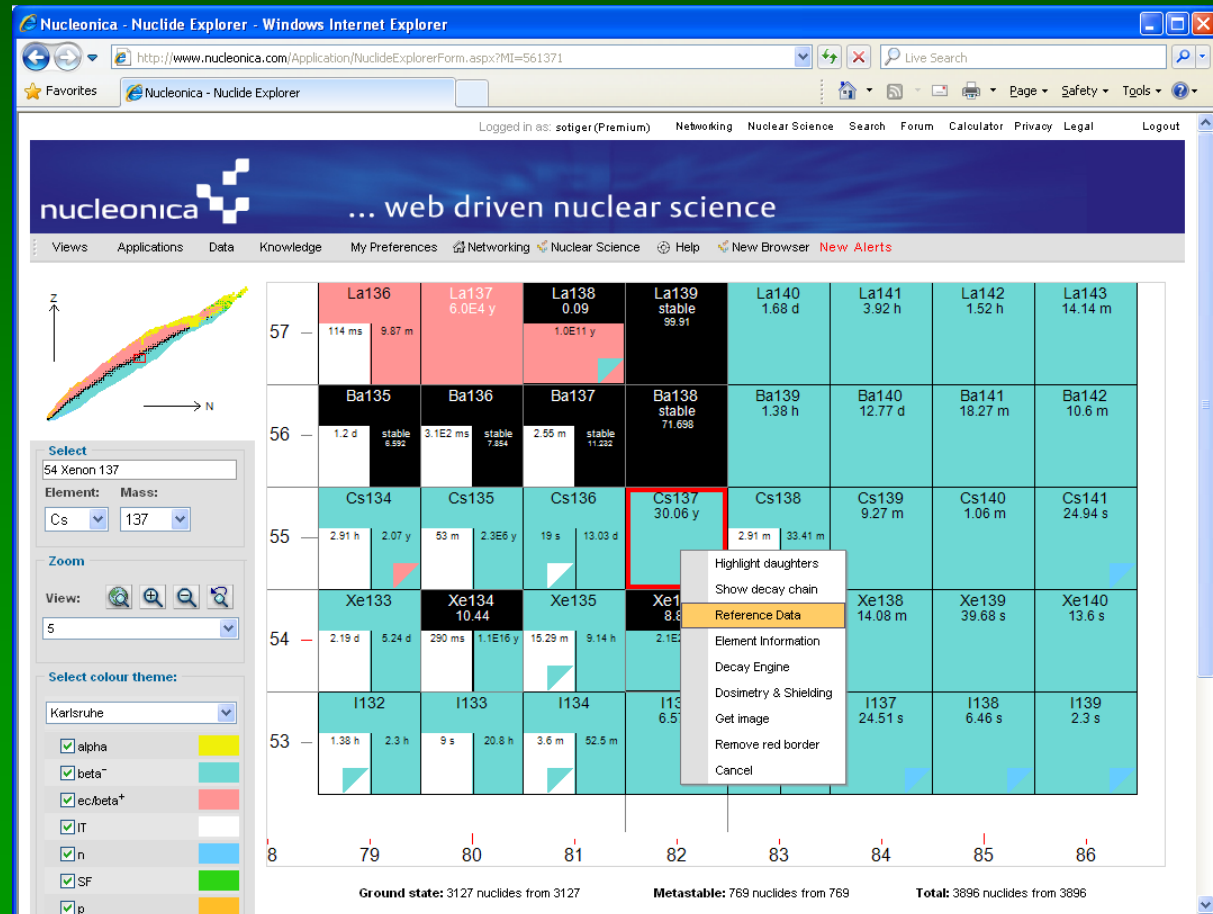


Solution – Exercise 7



Nuclide Explorer - Exercise 8

- Find the most important gamma line of Cs-137



Solution – Exercise 8

Nucleonica - Nuclide Datasheets - Windows Internet Explorer

http://www.nucleonica.com/Application/Datasheet.aspx?TI=4&MI=561371

Logged in as: sotiger (Premium) Networking Nuclear Science Search Forum Calculator Privacy Legal Logout

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Applications Data Knowledge My Preferences Print Networking Nuclear Science Help New Browser New Alerts

Version: 2012.06.12 16:40:16

Ba137
2.55 m stable 11.222
Nuclide Datasheets
56 Barium
Current Chart: Karlsruhe

Element Mass
Ba 137 m

Reference Data Description Derived Data Cross Sections Radiations Prompt Gammas Select Print Outputs

Nucleonica
☒ Gamma Rays ☐ Discrete Electrons ☒ X-rays and Annihilation Radiation
Update ☐ Show details

Questions, remarks, suggestions can be posted in the [forum](#)

Gamma Rays

Number of lines: 1
Sum E.P (eV per disintegration): 5.96E+05

Energy, E(keV)	Emission Probability, E.P.	α_{Total}	α_{K}	α_{L}
661.657	0.9007	0.1102	0.0896	0.0167

Download ☒ Excel ☐ CSV Separator: Semicolon (";") ☒ Use field qualifier ("")

Graph

Nuclear Data Retrieval

- Nuclear Data Retrieval
 - Nuclide Search
 - Radiation Search
 - Dose Coefficients Search

Nuclear Data Retrieval



Nucleonica - Search - Windows Internet Explorer

http://www.nucleonica.com/Application/Search.aspx?T=DR

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Nuclear Data Retrieval

Nucleonica EGAF Prompt Gammas Dose Coefficients (ICRP 68 & 72) 8th Table of Isotopes

Nucleonica quick link

Nuclide Search **Radiation Search** Advanced Search

Radiation Search - Search Variables & Range

☒ Gamma and X-Rays Energy: +/- keV
☐ Alpha +/- keV
 +/- keV

Emission probability: -

Atomic number Z: Element:

Mass number A: -

Half-life: Seconds - Seconds

Table print options
☐ Energy uncertainty
☐ E.P. uncertainty
☒ Half-life

Search Save to my defaults Reset my defaults Clear

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Gamma Energies in Nucleonica: > 53,000 Energies

Logged in as: magill Networking Nuclear Science Search Forum Calculator Privacy Legal

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Applications My Preferences Print Help

Nuclear Data Retrieval

Nucleonica/JEFF-3.1 EGAF Prompt Gammas ICRP 8th Table of Isotopes

Select Database: **Nucleonica**

Nuclide Search **Radiation Search** Advanced Search

Radiation Search – Search Variables & Range

☒ **Gamma and X-Rays** ☐ Alpha

Energy: +/- keV

+/- keV

+/- keV

Z: Element:

Mass number: -

Half-life: Seconds Seconds

Search **Save to my defaults** **Reset**

Search returned 53617 results
Number of nuclides (ground + isomeric states): 1325

Nuclides	Gamma and X-Rays (keV)	Emission Probability	Half-life
13 Al 24	9943.3	0.00027	2.053 (± 4) s
15 P 28	9793.8	0.00013	270.3 (± 5) ms

15 P 28	8015.3	0.0004	270.3 (± 5) ms
4 Be 11	7974.7	0.017400009	13.81 (± 8) s
19 K 36	7969.5	0.001271	342 (± 2) ms
15 P 28	7932.4	0.0215	270.3 (± 5) ms
13 Al 24	7930.86	0.0134	2.053 (± 4) s
19 K 36	7708.6	0.001722	342 (± 2) ms
15 P 28	7699.32	2E-05	270.3 (± 5) ms
13 Al 24	7615.17	0.00224	2.053 (± 4) s
15 P 28	7601	0.0055	270.3 (± 5) ms
15 P 28	7535.7	0.085	270.3 (± 5) ms
15 P 28	7414.92	0.0021	270.3 (± 5) ms
19 K 48	7400	0.002106	6.8 (± 2) s
15 P 28	7379.54	7.5E-05	270.3 (± 5) ms
13 Al 24	7347.83	0.00153	2.053 (± 4) s
5 B 14	7339	0.0095	12.5 (± 5) ms
19 K 48	7300.9	0.02418	6.8 (± 2) s
6 C 15	7299.2	7.400032E-05	2.449 (± 5) s
19 K 36	7177.6	0.003772	342 (± 2) ms
7 N 16	7115.15	0.0499999872	7.13 (± 2) s
13 Al 24	7069.5	0.43	2.053 (± 4) s
35 Br 88	7000.3	0.002268	16.5 (± 1) s
7 N 16	6915.5	0.00039999976	7.13 (± 2) s
15 P 28	6877.88	4.5E-05	270.3 (± 5) ms
19 K 36	6866.2	0.000902	342 (± 2) ms
15 P 28	6808.9	0.0333	270.3 (± 5) ms
4 Be 11	6790.5	0.04510011	13.81 (± 8) s
35 Br 86	6768.9	0.00096	55.0 (± 8) s
19 K 36	6729	0.00451	342 (± 2) ms
5 B 14	6726.5	0.086	12.5 (± 5) ms
35 Br 86	6722	0.000448	55.0 (± 8) s

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Europäische Kommission

Nuclear Data Retrieval - Exercise 9

Find the nuclides with gamma lines at 81, 303 and 356 keV with an uncertainty of ± 1 keV.

The screenshot shows the Nucleonica web application in a Windows Internet Explorer browser. The page title is "Nucleonica - Search". The URL is <http://www.nucleonica.com/Application/Search.aspx?T=DR>. The user is logged in as "sotiger (Premium)". The page features a navigation bar with links: Applications, Data, Knowledge, My Preferences, Print, Networking, Nuclear Science, Help, New Browser, and New Alerts. The main heading is "Nuclear Data Retrieval". Below this, there are tabs for "Nucleonica", "EGAF Prompt Gammas", "Dose Coefficients (ICRP 68 & 72)", and "8th Table of Isotopes". The "Radiation Search" tab is selected. The "Radiation Search - Search Variables & Range" section contains the following fields:

- ☒ Gamma and X-Rays
- ☐ Alpha
- Energy: 81 +/- 1 keV, 303 +/- 1 keV, 356 +/- 1 keV
- Emission probability: -
- Atomic number Z: -
- Mass number A: -
- Half-life: - Minutes - Seconds

On the right, there are "Table print options":

- ☐ Energy uncertainty
- ☐ E.P. uncertainty
- ☒ Half-life

At the bottom, there are buttons: "Search" (circled in red), "Save to my defaults", "Reset my defaults", and "Clear".

Solution – Exercise 9

Nucleonica - Search - Windows Internet Explorer

http://www.nucleonica.com/Application/Search.aspx?T=DR

Live Search

Refresh (F5)

Nucleonica - Search

EGAP Prompt gammas Dose Coefficients (ICRP 68 & 72) 8th Table of Isotopes

Nucleonica quick link

Nuclide Search Radiation Search Advanced Search

Radiation Search – Search Variables & Range

☒ **Gamma and X-Rays** Energy: 81 +/- 1 keV
☐ **Alpha** 303 +/- 1 keV
 356 +/- 1 keV

Emission probability: -
 Atomic number Z: Element:
 Mass number A: -
 Half-life: Minutes - Seconds

Table print options
☐ Energy uncertainty
☐ E.P. uncertainty
☒ Half-life

Search Save to my defaults Reset my defaults Clear

Search returned 7 results
 Number of nuclides (ground + isomeric states): 2

Nuclides	Gamma and X-Rays (keV)	Emission Probability	Half-life
56 Ba 133	356.013	0.62	10.54 (± 1) y
56 Ba 133	80.9979	0.329	10.54 (± 1) y
56 Ba 133	302.851	0.183	10.54 (± 1) y
91 Pa 228	81.2	0.00024	22 (± 1) h
91 Pa 228	303.2	0.000128	22 (± 1) h
91 Pa 228	80.1	6.8E-05	22 (± 1) h
91 Pa 228	356.96	2.24E-05	22 (± 1) h

Download ☒ Excel ☐ CSV Separator: Semicolon (",") ☒ Use field qualifier (")

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Nuclear Data Retrieval - Exercise 10

Find the Cs isotopes which have a half-life in the range 2 weeks -100 years.

The screenshot shows the Nucleonica search interface in a Windows Internet Explorer browser. The address bar displays the URL <http://www.nucleonica.com/Application/Search.aspx?T=DR>. The page title is "Nucleonica - Search".

The interface includes several tabs: "Nucleonica", "EGAF Prompt Gammas", "Dose Coefficients (ICRP 68 & 72)", and "8th Table of Isotopes". A "Nucleonica quick link" is also present.

The "Nuclide Search" tab is active, showing the "Nuclide Search - Search Variables & Range" section. The search criteria are as follows:

- Atomic number Z:
- Mass Number A: -
- Stable/Primordial: ☐
- Half-life: ☒ (Selected)
- Isomers: ☐
- Decay Mode: ☐

The half-life range is specified as 2 Weeks to 100 Years.

The "Element" dropdown menu is set to "Cs" (Cesium), which is circled in red.

The "Table print options" section on the right includes the following checkboxes:

- ☐ Decay mode
- ☒ Half-life
- ☒ Abundance
- ☐ Spin
- ☐ Parity
- ☐ Daughter Product
- ☐ Branching Ratio
- ☐ Q-Value

The "Search" button is circled in red, along with the "Element" dropdown menu.

Solution – Exercise 10

Nucleonica - Search - Windows Internet Explorer

http://www.nucleonica.com/Application/Search.aspx?T=DR

File Edit View Favorites Tools Help

★ Favorites Nucleonica - Search

Nuclide Search Radiation Search Advanced Search

Nuclide Search – Search Variables & Range

Atomic number Z: Element: Cs

Mass Number A: -

☐ Stable/Primordial ☐ Half-life ☐ Isomers ☐ Decay Mode

2 Weeks - 100 Years

Table print options

- ☐ Decay mode
- ☒ Half-life
- ☒ Abundance
- ☐ Spin
- ☐ Parity
- ☐ Daughter Product
- ☐ Branching Ratio
- ☐ Q-Value

Search Save to my defaults Reset my defaults Clear

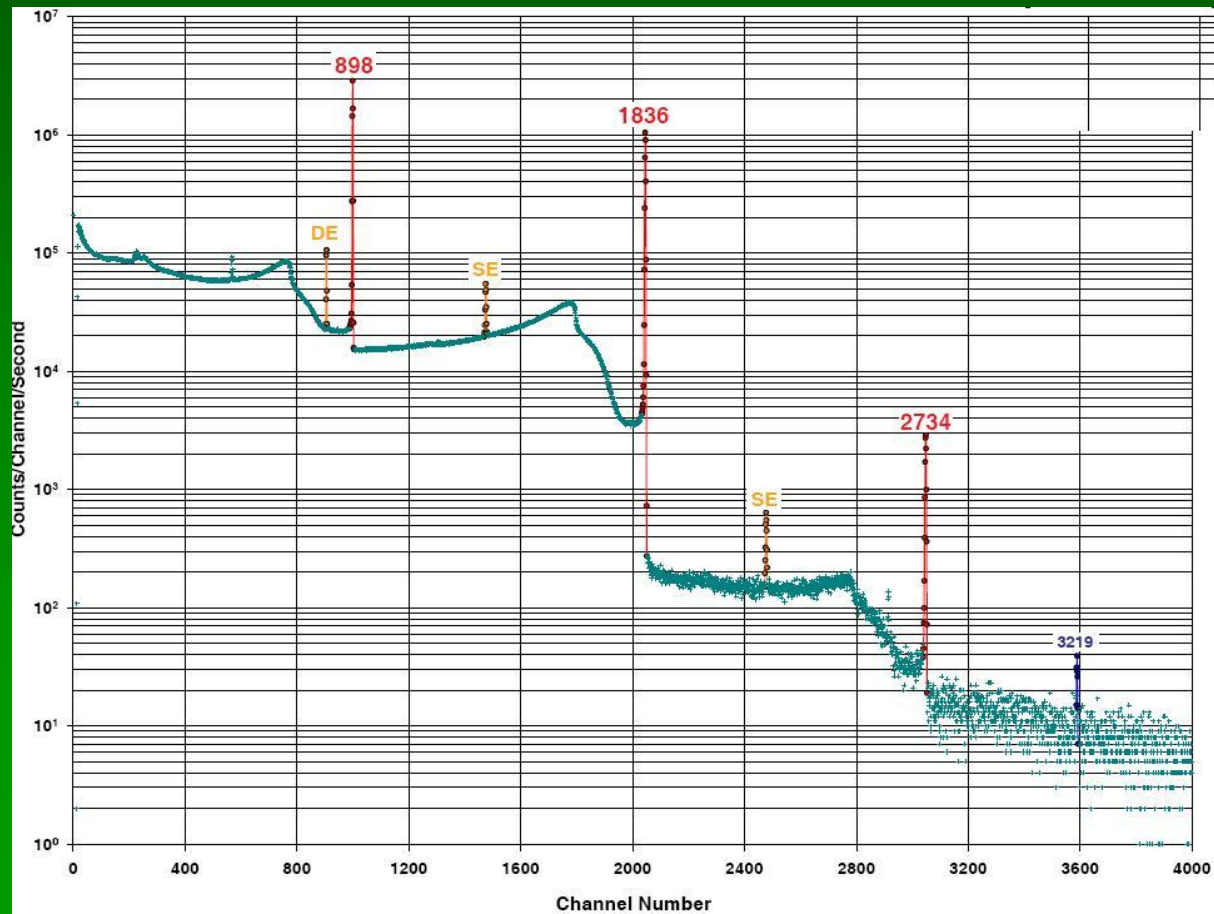
Search returned 2 results
Number of nuclides: 2

Nuclides	Half-life	Abundance (atom %)
55 Cs 134	2.0651 (± 6) y	
55 Cs 137	30.04 (± 3) y	


Download ☒ Excel ☐ CSV Separator: Semicolon (",") ☒ Use field qualifier ("")

Nuclear Data Retrieval - Exercise 11

See gamma spectrum below –
to which isotope does this correspond?



Solution - Exercise 11



Nuclear Data Retrieval

[Nucleonica](#) [EGAF Prompt Gammas](#) [Dose Coefficients \(ICRP 68 & 72\)](#) [8th Table of Isotopes](#)

[Nucleonica quick link](#)

[Nuclide Search](#) [Radiation Search](#) [Advanced Search](#)

Radiation Search – Search Variables & Range
☒ **Gamma and X-Rays** Energy: +/- keV
☐ **Alpha** +/- keV
 +/- keV

Z: Element:
Mass number: –
Half-life: –

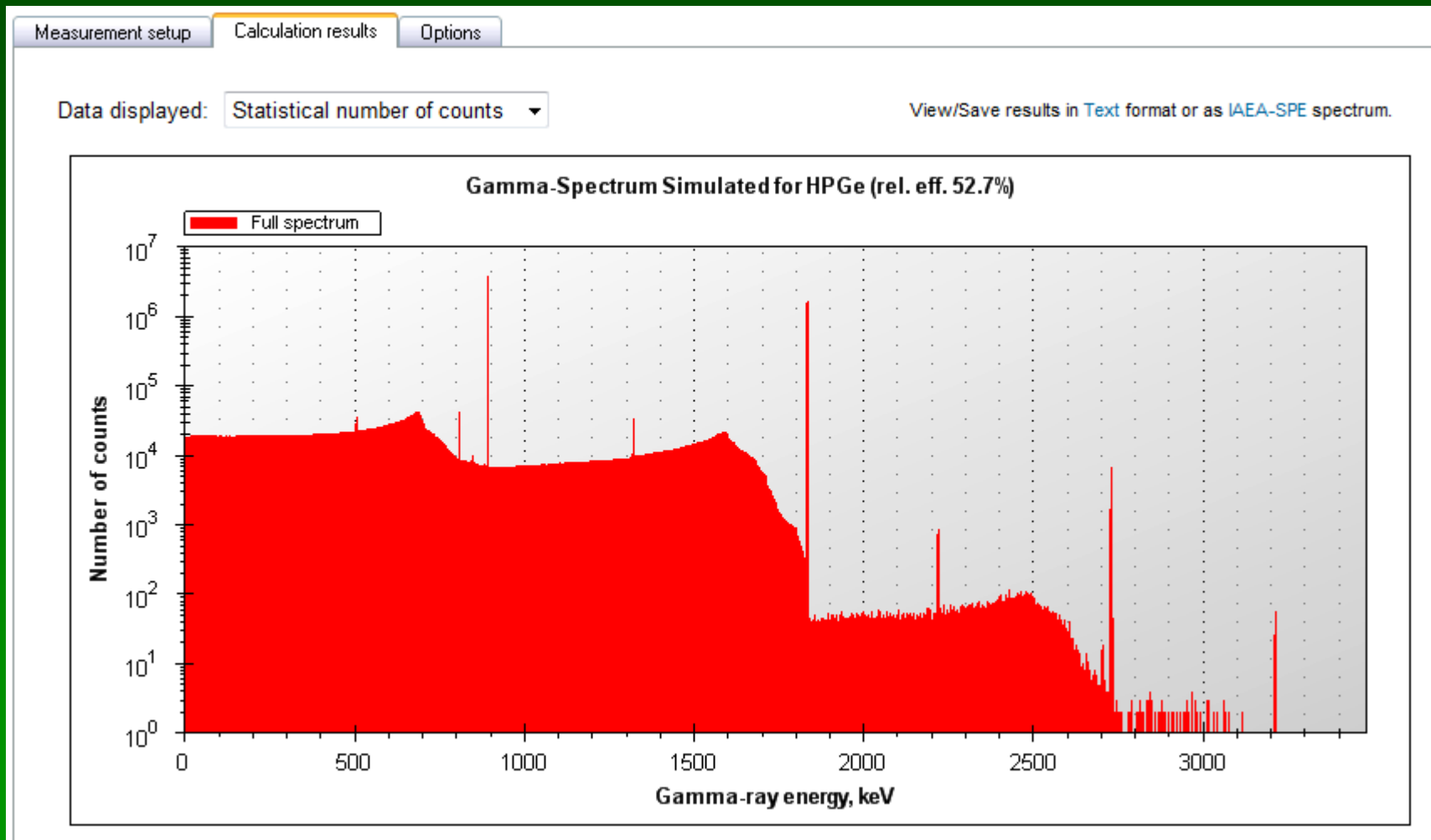
Search returned 6 results
Number of nuclides (ground + isomeric states): 2

Nuclides	Gamma and X-Rays (keV)	Emission Probability
39 Y 88	2734.07	0.00614
37 Rb 88	2734.04	0.0011
39 Y 88	1836.05	0.9932
37 Rb 88	1836.02	0.224
39 Y 88	898.036	0.939
37 Rb 88	898.02	0.147

☒ Excel ☐ CSV Separator: ☒ Use field qualifier ("")



Check with Gamma Spectrum Generator, if we can reproduce the spectrum...



Physical Constants

Nucleonica - Portal - Windows Internet Explorer

http://www.nucleonica.com/Application/portal.aspx

Application Centre

- Mass Activity Calculator, **New: Mass Activity Calculator**
- Decay Engine
- Dosimetry & Shielding
- Range & Stopping Power
- In Silico Dosimetry
- webKORIGEN
- Decay Engine for Large Nuclide Sets
- Universal Nuclide Chart
- Transport & Packaging
- Nuclide mixtures
- Nucleonica Scripting
- Gamma Spectrum Generator
- Gamma Spectrum Generator Pro
- Virtual Cloud Chamber
- Cambio file Converter
- WESPA
- Gamma Library
- webGraph

Search Nucleonica Documentation

Nuclear Data Retrieval

nucleonica [wiki]

Data Centre

- Physical Constants
- Nuclide Explorer
- Nuclide Datasheets (Reference Data, Derived Data, Sections, Radiations)
- Nuclear Data Retrieval (Nuclide Search, Radiological Coefficients)
- Fission Yields
- Universal Nuclide Chart

Knowledge Centre

- Nuclear News
- Reading room
- Useful Weblinks

Nucleonica - Physical Constants - Windows Internet Explorer

http://www.nucleonica.com/Application/Constants.aspx

Physical Constants

Radiological Limits

Workers

Dose Limits for exposed workers	Euratom	ICRP	IAEA	Germany
Limit on effective dose for exposed workers in a consecutive 5 years period:	100 mSv	20 mSvly	20 mSvly	20 mSvly
Maximum effective dose in any single year:	50 mSvly	50 mSvly	50 mSvly	50 mSvly
Equivalent dose limit to the foetus, accumulated over the period of time between declaration of pregnancy to the delivery date:	1 mSv	2 mSv		1 mSv
Pregnant woman				2 mSv/m
Total work life (50 y)				400 mSv
Partial body exposure:				
Limit on equivalent dose for the lens of the eyes:	150 mSvly	150 mSvly	150 mSvly	150 mSvly
Limit on equivalent dose for the skin:	500 mSvly	500 mSvly	500 mSvly	500 mSvly
Limit on equivalent dose for the hands, forearms, feet and ankles:	500 mSvly	500 mSvly	500 mSvly	500 mSvly

Nuclear Data Applications

- Universal Nuclide Chart
- Nuclide Data Sheets
 - Reference Data
 - Derived Data
 - Radiations
- Nuclide Explorer
- Nuclear Data Retrieval
 - Nuclide Search
 - Radiation Search
 - Dose Coefficients Search
- Karlsruhe Chart of Nuclides

Fission Yields

Nucleonica - Portal - Windows Internet Explorer

http://www.nucleonica.com/Application/portal.aspx

File Edit View Favorites Tools Help

Nucleonica - Portal

Actual Chart: Binding Energy

Search Nucleonica Documentation

Nuclear Data Retrieval

nucleonica [wiki]

- » Universal Nuclide Chart
- » Transport & Packaging transport assistant **New:** e-Ship: radiological
- » Nuclide mixtures
- » Nucleonica Scripting
- » Gamma Spectrum Generator
- » Gamma Spectrum Generator Pro
- » Virtual Cloud Chamber
- » Geant4 Dosimetry
- » easy Monte Carlo
- » Cambio file Converter
- » WESPA
- » Gamma Library
- » webGraph

» Data Centre

- » Physical Constants
- » Nuclide Explorer
- » Nuclide Datasheets (Reference Data, Derived Data, Cross Sections, Radiations) (Prompt Gammas)
- » Nuclear Data Retrieval (Nuclide Search, Radiation Search, Dose Coefficients)
- » **Fission Yields**
- » Universal Nuclide Chart
- » Karlsruhe Nuclide Chart
- » KNC Nuclide Icon
- » Energy Level Diagram
- » Periodic Table

» Knowledge Centre

- » Nuclear News
- » Reading room

» My Nuclide Mixtures

- » Enriched Uranium
- » Transuranics in 1 ton Si (4.2% enriched, 500W cooling)
- » Highly Enriched Uranium
- » U-U
- » SRM 071 U isotopes since July 1977

» My Sources

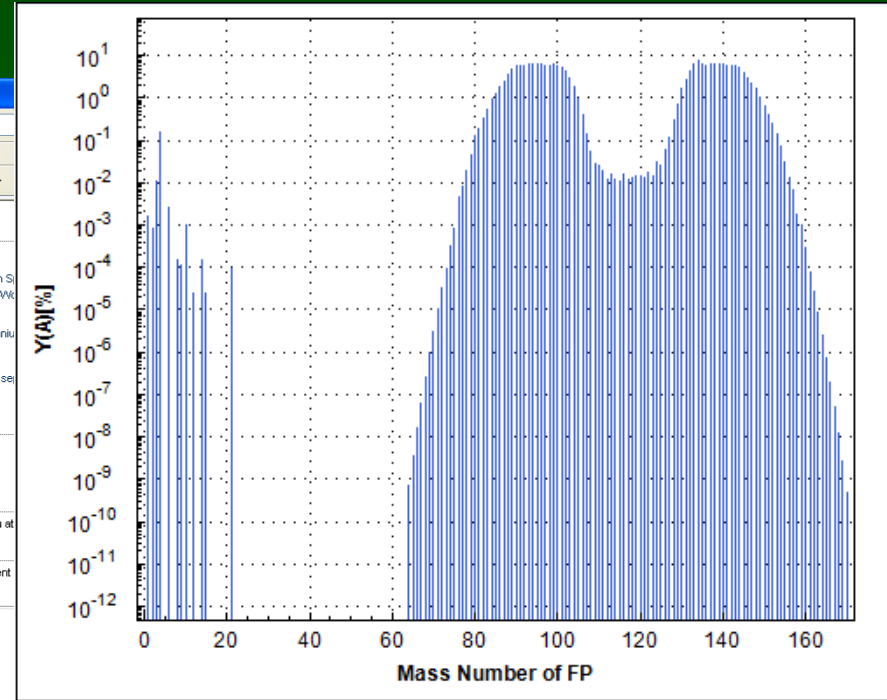
- » F-18
- » xxx

» My Messages

No messages for you at the moment

» User Alerts

No alerts at the moment



Data sources:

JEFF 3.1, ENDF-BVI,

JENDL 3.2 libraries

Fission Yields – Exercise 12

Find the thermal neutron fission products of U-235.

How many fission product are listed in JEFF

U235
0.7204
26 m 7.0E8 y

Fission Yields
92 Uranium

Current Chart: Karlsruhe

Element: Mass:
U 235

Select Fission Yields

Library: JEFF-3.1 Type of fission: Thermal fission

Fission Yields Settings

Element Mass Number
Min Half-life Seconds
Max Half-life Seconds ☒ Enable advanced comparison

Results Reset

U235
0.7204
26 m 7.0E8 y

Fission Yields
92 Uranium

Current Chart: Karlsruhe

Element: Mass:
U 235

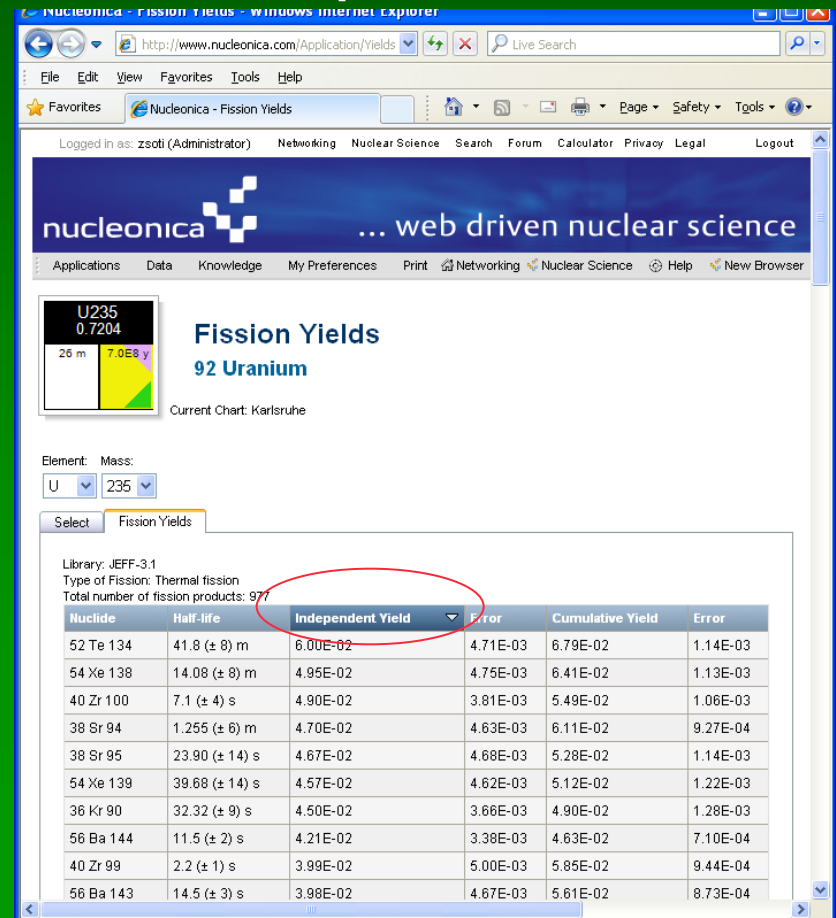
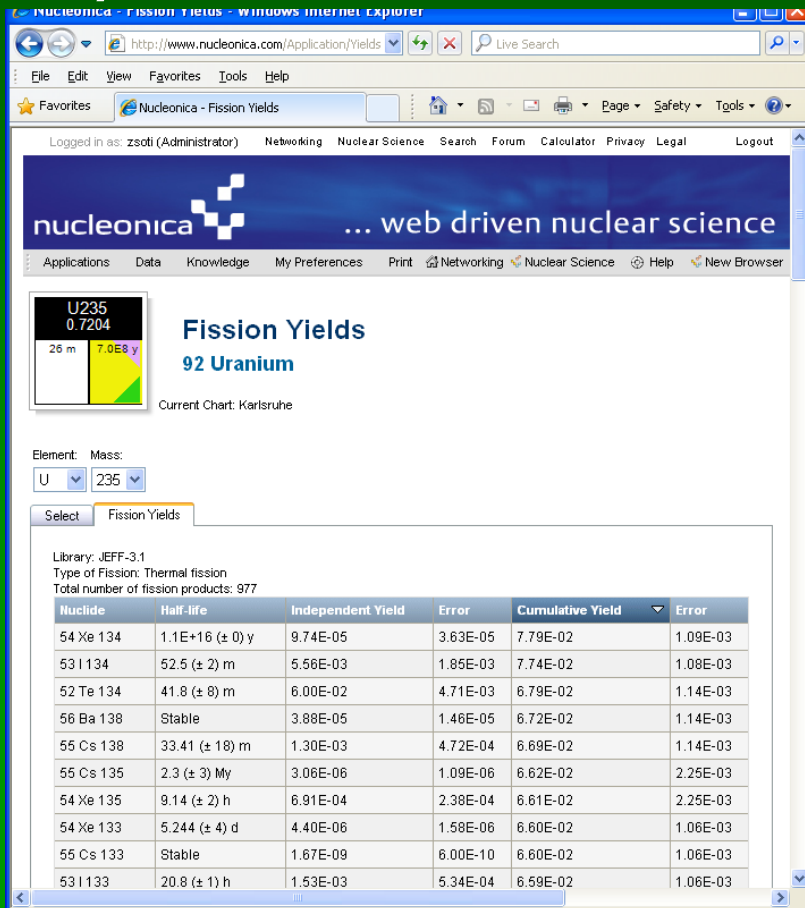
Select Fission Yields

Library: JEFF-3.1
Type of Fission: Thermal fission
Total number of fission products: 977

Nuclide	Half-life	Independent Yield	Error	Cumulative Yield	Error
54 Xe 134	1.1E+16 (± 0) y	9.74E-05	3.63E-05	7.79E-02	1.09E-03
53 I 134	52.5 (± 2) m	5.56E-03	1.85E-03	7.74E-02	1.08E-03
52 Te 134	41.8 (± 8) m	6.00E-02	4.71E-03	6.79E-02	1.14E-03
56 Ba 138	Stable	3.88E-05	1.46E-05	6.72E-02	1.14E-03
55 Cs 138	33.41 (± 18) m	1.30E-03	4.72E-04	6.69E-02	1.14E-03
55 Cs 135	2.3 (± 3) My	3.06E-06	1.09E-06	6.62E-02	2.25E-03
54 Xe 135	9.14 (± 2) h	6.91E-04	2.38E-04	6.61E-02	2.25E-03
54 Xe 133	5.244 (± 4) d	4.40E-06	1.58E-06	6.60E-02	1.06E-03
55 Cs 133	Stable	1.67E-09	6.00E-10	6.60E-02	1.06E-03
53 I 133	20.8 (± 1) h	1.53E-03	5.34E-04	6.59E-02	1.06E-03

Fission Yields – Exercise 13

Which fission products have the highest yields? Give cumulative and independent



Fission Yields – Exercise 14

What are the cumulative fission yields of Cs 137?

U235
0.7204
26 m 7.0E8 y

Fission Yields
92 Uranium

Current Chart: Karlsruhe

Logged in as: zsoti (Administrator) Networking Nuclear Science Search Forum Calculator Privacy Legal Logout

Applications Data Knowledge My Preferences Print Networking Nuclear Science Help New Browser

Element: Mass:
U 235

Select Fission Yields

Library: JEFF-3.1 Type of fission: Thermal fission

Fission Yields Settings

Element Mass Number
Cs

Min Half-life Seconds

Max Half-life Seconds ☐ Enable advanced comparison

Results Reset

U235
0.7204
26 m 7.0E8 y

Fission Yields
92 Uranium

Current Chart: Karlsruhe

Logged in as: zsoti (Administrator) Networking Nuclear Science Search Forum Calculator Privacy Legal Logout

Applications Data Knowledge My Preferences Print Networking Nuclear Science Help New Browser

Element: Mass:
U 235

Select Fission Yields

Library: JEFF-3.1
Type of Fission: Thermal fission
Total number of fission products: 24

Nuclide	Half-life	Independent Yield	Error	Cumulative Yield	Error
55 Cs 138	33.41 (± 18) m	1.30E-03	4.72E-04	6.69E-02	1.14E-03
55 Cs 135	2.3 (± 3) My	3.06E-06	1.09E-06	6.62E-02	2.25E-03
55 Cs 133	Stable	1.67E-09	6.00E-10	6.60E-02	1.06E-03
55 Cs 139	9.27 (± 5) m	1.19E-02	3.66E-03	6.31E-02	8.87E-04
55 Cs 137	30.04 (± 3) y	7.22E-04	2.56E-04	6.22E-02	6.94E-04
55 Cs 140	1.062 (± 5) m	2.11E-02	4.99E-03	6.02E-02	9.66E-04
55 Cs 141	24.94 (± 6) s	3.27E-02	4.98E-03	4.84E-02	1.65E-03
55 Cs 142	1.70 (± 2) s	2.40E-02	4.89E-03	2.92E-02	2.63E-03
55 Cs 143	1.791 (± 7) s	1.57E-02	4.25E-03	1.65E-02	3.09E-03
55 Cs 144	994 (± 4) ms	2.06E-03	7.35E-04	3.17E-03	7.76E-04

Thank You